Bulletin No. 58

October 31, 1922.

COMMONWEALTH OF PENNSYLVANIA

DEPARTMENT OF INTERNAL AFFAIRS
James F. Woodward, Secretary

BUREAU OF TOPOGRAPHIC AND GEOLOGICAL SURVEY
George H. Ashley, State Geologist

POTASH FIASCO IN TIOGA COUNTY, PENNSYLVANIA

By R. W. Stone

and

Simple Tests for Potash, by W. B. Hicks

Mountain of Potash reported. The discovery of a mountain of potash near Davis Station, Tioga County, was reported in the newspapers in the summer of 1919, but efforts of the Pennsylvania Geological Survey to obtain any evidence of the occurrence of potash in more than the most meager quantity have proved fruitless.

Professor William Frear of State College investigated the matter, ascribed the source of the potash to cave guano and his findings were published in The American Fertilizer, August 30, 1919. As seemingly undiminished interest in the reported deposit continued, Professor Benjamin L. Miller of Lehigh University examined the locality in August 1920 and submitted a report to the State Geologist which was used in answering correspondence, but was not published. The present writer went to Davis in August 1922 shortly after the publication of a newspaper item purporting that a mill was to be built for treating the ore.

What is potash? The form of potash found near Davis Station was niter, or saltpeter (stone salt, so called because it exudes from rocks). It is a colorless or white crystalline substance with a cooling, saline taste, known chemically as potassium nitrate (KNO_3). Potassium nitrate contains 39 per cent potassium (K) equivalent to 47 per cent "potash" (K_2O). It is formed by the action of microbes on nitrogen-bearing organic bodies, taken in solution by surface water and crystallized out where the water evaporates, usually in caves or on rock surfaces protected from the weather. Saltpeter derived from bat guano formed in caves in the southern States was utilized during the Civil War for making gun powder. It is now prepared artificially and used in making explosives, fireworks, and matches, and also as a food preservative, flux, and in medicine.

Incrustations of potassium nitrate on the surface of rock ledges protected from the weather are not uncommon, having been formed in many places throughout the country. From the nature of their origin the quantity of material is usually small and lacks commercial value.

Location. Tioga County is near the middle of the north boundary of Pennsylvania. Davis Station is near the west border of the county in Clymer township on the Buffalo and Susquehanna Railroad and on Long Run, five miles north of Gaines. This place was formerly known as Lansing (a postoffice which has been discontinued). The supposed potash-bearing rocks and the mining development are on the hillside northeast of and about 400 yards from the railroad station.

Discovery. The original discovery of potash at this place was not recent. According to Prof. Miller, many years ago farmers in the neighborhood obtained saltpeter here for curing meat. The salt occurred as thin layers of white coating on the rocks. In 1918, James McCullough, whose father was one of the early users of saltpeter from this locality, recalled the occurrence, and with his son, Simon McCullough, made an investigation to determine if the deposit had commercial value. Samples were taken and reports on the analyses were so favorable that the two McCulloughs took an option on the land and interested other men in purchasing the property. A company was formed and stock sold to get money for building a mill to refine potassium nitrate. The company however soon learned that the proposition was impracticable, refunded the money paid for stock, and disorganized.

Development. The owners of the land thereupon investigated in their own interests, arranged for two diamond drill test holes, and formed a new company. One diamond drill hole was sunk near the ledge of rock bearing saltpeter, and the other about one quarter mile southeast. Both of them are reported to have been 300 feet deep, and drill cores carefully preserved and analyzed. According to Mr. McCullough and current newspapers, the cores of the first hundred feet from the surface contained about 1 per cent of potassium nitrate. It was claimed also that there was a considerable loss of nitrate by solution during drilling.

The new company, known as the Pennsylvania Potash and Fertilizer Company, Westfield, Pa., was incorporated with a capitalization of $350,000. Having acquired 640 acres plans were made to erect a mill on the hillside below the mine. This mill was to reduce the rock to a powder, which was to be bagged and sold as a fertilizer. Sufficient profit was expected from the sale of crushed rock for fertilizer to build eventually a large mill for extracting and refining potassium nitrate.

A tunnel (adit) was driven in the hillside about 250 feet above the railroad in 1920. It is in nearly horizontal sandstone, penetrates the hill about 100 feet, and at the inner end turns to the left 15 feet to a raise, the height of which was not determined. A second tunnel was driven about 100 feet higher on the hill in the spring of 1921. Twenty feet of open cut through hillwash, 100 feet of tunnel in thin-bedded sandstone, and a raise at the inner end,

said to reach the surface, constitute the latest development work. Timber was used only at the entries of these openings because the sandstone roof was solid. A cabin and blacksmith shop at the mouth of the lower tunnel were the only buildings. Drills were operated with compressed air.

No mining development has been done on this property since the spring of 1921; in August 1922 the entries of underground workings were caving, and the project presumably is abandoned.

Source of the potash. Geologically the region is one of the flat-lying sedimentary rocks. The upper part of the valley and the neighboring hilltops are underlain by greenish-gray sandstones of the Oswago (Pocono) formation. The bottom of the valley at Davis is cut in reddish shales and sandstones of the Cattaraugus (Catskill) formation of Devonian age.

Professor William Frear of Pennsylvania State College says:[1] "The deposit reported was one of niter or saltpeter, the nitrate of potassium. This compound is formed in every soil by the action of certain bacteria upon nitrogen-containing organic matter. We are not certain that, in nature, it is formed in considerable quantity in any other way. It appears in encrustations upon the soils of arid regions, and, in humid regions, in locations protected from the rain, such as covered barnyards, stable floors, bat caves, etc.

"As the material is very soluble in water, large accumulations do not occur in the soils of humid regions; the drainage waters carry it away. Deep artesian wells often contain a very little nitrate. It is probably present in the moisture contained in many rocks, so far as that moisture is derived from soil drainage. No large accumulations are known in the humid regions of the world in any subsurface rock. These facts make improbable the existence in Pennsylvania of any great rock-contained deposit of saltpeter.

"The rock in question is a weathered mass of small size projecting from the hillslope. It is much stratified, that is, made up of numerous thin layers with considerable crevices protected from the action of rain. White to brownish white encrustations appear on the surfaces of these crevices in the middle and lower parts of the exposed front of this jutting rock. This encrustation, a sample of which I took, contains niter.

"However, several facts of possible importance give rise to a question as to the immediate source of this niter and as to the extent to which the encrustation extends through the great body of rock of which this jutting point forms a very small part. I was told that this outcrop had long been known locally as "the saltpeter rock," but that other outcrops at the same elevation on the same hill had no such repute. The "saltpeter rock" contains a large cave, the floor of which is covered with the dung of wild animals. This dung may be

---

[1] No Potash in Pennsylvania: The American Fertilizer, p. 58, Aug. 30, 1919.

the source of the saltpeter. Whether the niter encrustations appear also in the great mass of the rock back under the hill is now being determined. If they do not, the deposit is scientifically interesting but not commercially important."

Professor B. L. Miller of Lehigh University reported as follows regarding the same occurrence:- "The deposit where first discovered lies about 400 or 500 feet above the level of the stream. The slope of the hill is covered with angular blocks and slabs of the greenish-gray sandstone, but with few exposures of the rock in place. The exception is a cliff about 15 feet in height and extending longitudinally about 30 or 40 feet. This exposure consists of thin bedded greenish-gray micaceous sandstones in which marked cross bedding is observable. Few of the layers are more than one inch thick and many of them are so thin that they appear somewhat shaly. The slope of the hill being very steep, large blocks of this rock have been slightly dislocated, opening up numerous cracks and furnishing a favorable place for the woodchucks to live in. It seems that they must be very numerous, as heaps of their droppings can be found all through these openings. It is thought that the potassium nitrate in part, at least, comes from this source. Along the bedding planes and many of the joint planes as well, there is a deposit of white material that effervesces vigorously and is apparently composed, in the main, of calcium carbonate. This material is claimed to contain the potassium nitrate in its purest form, although rocks in which no surficial coating occurs are said to yield potassium nitrate on analysis. This statement has not been verified to our knowledge."

"Soil along the hillside and also in the floodplain of the small stream below is reported as carrying several per cent of potassium nitrate, and yielding unusual crops. Nothing of this was apparent in August. The soil of the hillside seemed to be no more fertile than any other soil of the county. In fact, the vegetation did not appear so vigorous as in many other places."

"The conclusion reached is that, in all probability, potassium nitrate is present in the region, contained in the white incrustation which is mainly calcium carbonate. This occurrence could be accounted for by leaching of the woodchuck manure that is abundant in the crevices of the rock. No opinion can be expressed in regard to the claim that potassium nitrate was found in the rocks themselves or in the crevices in the strata penetrated by the diamond drill. If these cores contained potassium nitrate, there must be an additional source for the material. The presence of a small amount of potassium nitrate in the rock could be explained as coming from the mica which is fairly abundant in certain layers. That could account, however, for a very small amount."

Professor Miller collected samples of the rock bearing a white efflorescent coating which was claimed to contain potassium nitrate in its purest form. Several months after Professor Miller had written the foregoing statement, the following analyses of his samples were received from the Bureau of Chemistry, Pennsylvania Department of Agriculture:

Potash (K_2O) in rock from Davis Station, Tioga County.

Sample number	S-2268	S-2269	S-2270
	(per cent)	(per cent)	(per cent)
Rock	0.14	0.17	0.17
Incrustation	0.12	0.24	0.19

As these samples contained less than one-quarter of one per cent water soluble potash, the Geological Survey concludes that the reported recent discovery was a farce, and that the development work was a fiasco.

Simple Tests for Potash.[2]

By W. B. Hicks

Principles. Potassium is generally found in nature in solution, as soluble salts or saline residues, in organic substances, in alunite, and in silicate rocks and minerals. Simple methods for detecting and determining it are here described for the benefit of those who may be interested in making rough field tests. These tests have been used with good results by members of the United States Geological Survey and may be used successfully, it is believed, by any one with little or no experience in chemical manipulation. They depend on the fact that when a volatile potassium compound is heated in a flame it imparts a characteristic violet color to the flame. Though usually masked by the colors produced by other elements, especially sodium and calcium, the coloration due to potassium is readily seen and identified by observing the flame through a Merwin color screen.

Equipment. The equipment necessary for making the tests herein described consists of -

1. Lamp for volatilizing the potash compound. For this purpose an ordinary alcohol lamp with an asbestos wick will often suffice, but a gasoline or alcohol blast lamp, which requires no wick and which burns with a hot, nonluminous flame, gives far better results.

2. Platinum wire about 4 inches long. One end of the wire should be sealed in to the end of a short glass rod to serve as a handle, and the opposite end should be bent into the form of a small loop.

3. Merwin color screen.

4. Small beaker.

[2] Mineral Resources of the United States, 1915, part II. pp. 129-131, 1917.

5. Hydrochloric acid.

6. Gypsum or calcium sulphate.

Procedure for water and brines. First clean the loop of platinum wire by dipping it in hydrochloric acid and igniting it until the flame is no longer colored. By means of the clean platinum loop remove a drop of the solution to be tested, carefully evaporate it to dryness by holding over the flame, finally ignite, and observe the color of the flame through the Merwin color screen. The best results are obtained by using a black background, holding the Merwin screen close up against the eyes, and looking through the central section of the screen. If potassium salts are present, the flame will appear reddish to reddish violet, and the intensity and duration of the color will give some idea as to the amount of potassium.

Procedure for soluble salts. For detecting potassium in saline residues and soluble salts in general, as well as for detecting soluble potassium compounds in muds, clays, and ashes, proceed as follows: Dissolve a portion of the sample in a small quantity of water, allow the undissolved material to settle out, remove a drop of the clear solution by means of the loop of platinum wire, and test in the flame as just described for waters and brines.

In tests for alum and other sulphates the clear solution should be poured off from the insoluble residue and some hydrochloric acid added before making the test.

The water used in all such tests should be examined to see whether it contains potassium.

Procedure for organic substances. The substance to be tested is first ignited or burned at as low a temperature as possible until only the ash remains. The ash is then tested for potassium according to the procedure just described for soluble salts.

Procedure for alunite. Powder the sample to be tested and moisten it with hydrochloric acid. By means of the loop of platinum wire transfer a portion of the moistened powder to the flame, ignite, and observe the color of the flame through the Merwin color screen. If potassium is present, the flame will appear deep reddish violet.

Emphasis should be placed on the fact that this procedure is a test for potassium and not necessarily for alunite. Other potash-bearing materials, especially leucite and glauconite, will give similar results with such treatment.

Procedure for silicate rocks and minerals. In order to detect potassium in silicate rocks and minerals, such as feldspar, granite, leucite, rhyolite, glauconite, and sericite, powder the material finely, mix with an equal quantity of pure gypsum, and moisten the mixture with dilute hydrochloric acid. By means of the loop of platinum wire, transfer a portion of the moist mixture to the flame,

ignite, and observe the color of the flame through the Merwin color screen. The reddish violet color will be apparent if potassium is present.

Although with less satisfactory results, as a rule, the test may be carried out by mixing the material to be tested with either hydrochloric acid or gypsum alone.